

DENTON WHARF, MARK LANE, GRAVESEND, DA12 2PL

NET ZERO MARINE

FLOOD RISK ASSESSMENT

**REPORT REF.
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FEEDER PILLAR C

FEEDER PILLAR D

2x DNO KIOSK/UKPN GRP

DOCUMENT CONTROL SHEET

REV	ISSUE PURPOSE	AUTHOR	CHECKED	APPROVED	DATE
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1. Introduction

Preface

- 1.1. Ardent Consulting Engineers (hereafter referred to as Ardent) has been commissioned by Net Zero Marine to support a planning permission to install various pieces of infrastructure on and within the vicinity of Denton Jetty and Mark Lane in Gravesham.
- 1.2. This Flood Risk Assessment has been prepared with specific reference to the requirements of National Planning Policy Framework (NPPF) updated in December 2023 and the Planning Practice Guidance (PPG), updated in August 2022, which superseded the Technical Guidance to the NPPF in March 2014.

2. Site overview

Existing Site

- 2.1. The development is located at Denton Wharf, Mark Lane, Gravesend, DA12 2PL at national grid reference E566544, N174455 (hereafter referred to as the Site). Refer to **Figure 2-1** below and Red Line Application Boundary in Appendix A.



Figure 2-1: Site Location Plan

- 2.2. The Site is comprised of the Denton Jetty and an area of land to the north and south of the River Thames flood defence wall. The majority of the Site is situated on the River Thames.
- 2.3. The site is bound to the north, west and east by the River Thames and existing commercial development and Mark Lane to the south.
- 2.4. Access to the site is to the south via Mark Lane.

Development Proposals

- 2.5. The proposed development seeks to provide small-scale infrastructure which is

required to facilitate a shore power installation project at the Site on Denton Jetty and Mark Lane south of the flood defence wall in Gravesham (**Figure 2-2** below and **Appendix A**).

2.6. The required infrastructure comprises:

- 2No. Feeder Pillars B and 1 No. Metering (Feeder Pillar C) on Denton Jetty;
- 1 No. Feeder Pillar D adjacent the flood defence wall;
- 2 No. DNO Kiosk/UKPN GRP and 2 No. Feeder Pillars A immediately south of Mark Lane; and,
- Cabling is proposed below and above ground connecting the supply point immediately south of Mark Lane. Note the cabling between the supply point and Denton Jetty is to be laid underground south of the flood defence wall and then pass over the flood defence wall (not through it) before being laid above ground from the flood defence wall north towards Denton Jetty.
- Refer to **Appendix A** for details of Feeder Pillar's A, B, C, and D in addition to 2 No. DNO Kiosk/UKPN GRP.

2.7. The aim of the development is to shift towards low carbon energy. The implementation of Low Voltage Feeder Pillar's/cabinets/infrastructure and related electrical equipment will replace the usage of the existing diesel-fed equipment.

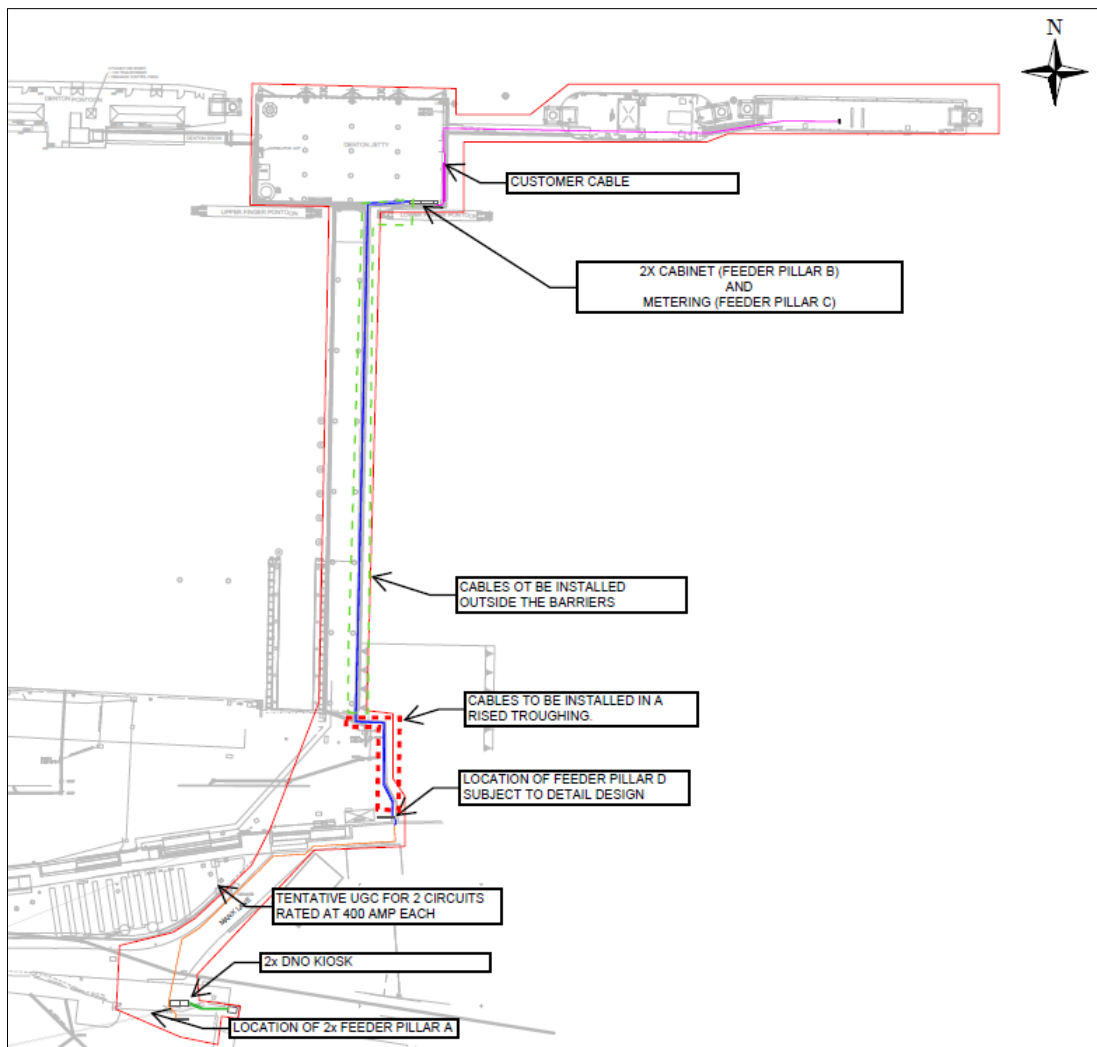


Figure 2-2: Proposed Infrastructure Elements

- 2.8. The 2 No. Feeder Pillars B and 1 No. Metering Feeder Pillar C, positioned on Denton Jetty will be elevated by 400mm above the current jetty level, with an overall height above existing jetty level of 2.40m and 1.695m respectively.
- 2.9. The 1 No. Feeder Pillar D located north of the flood defence wall will be elevated 400mm above existing ground levels, with an overall height of 1.90m.
- 2.10. The 2No. DNO Kiosk/UKPN GRP and 2No. Feeder Pillar's A off Mark Lane again will be elevated 400mm above existing ground level with an overall height of 1.90m and 2.00m respectively.
- 2.11. The cables connecting the southern feeder/supply point to Denton Jetty will be installed below and above ground.
- 2.12. The site currently site within Flood Zone 3 associated with the Tidal River Thames. Refer to **Figure 2-3** below.

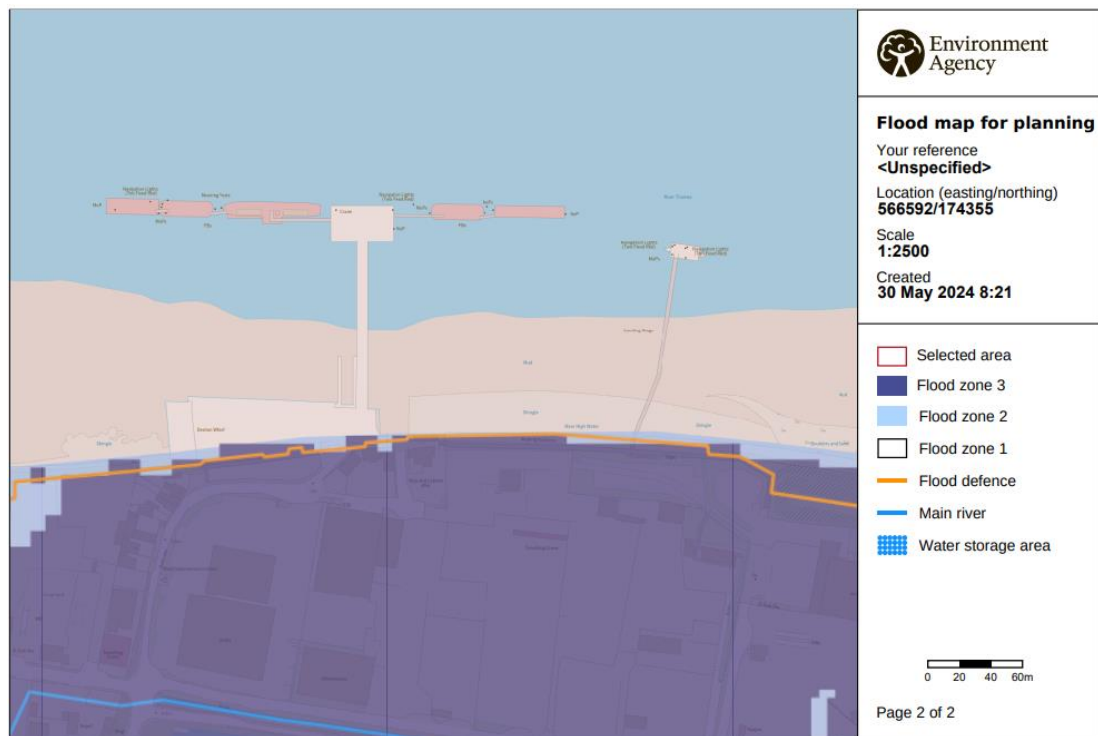


Figure 2-3: Flood Map

2.13. In terms of flood risk vulnerability, the proposed development is considered to be water compatible.

3. Policy Context

National Planning Policy Framework

- 3.1. The National Planning Policy Framework (NPPF) was introduced on 27 March 2012. This document was revised in December 2023; where paragraphs 165 to 175 inclusive establish the Planning Policy relating to flood risk management. The Technical Guide to the NPPF was superseded by the Planning Practice Guidance (PPG) in March 2014.
- 3.2. It states all plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change –to avoid where possible, flood risk to people and property. They should do this and manage residual risk, by:
- 3.3. a) applying the sequential test, and if necessary, the exception test as set out below;
- 3.4. b) safeguarding land from development that is required for current and future flood management;
- 3.5. c) using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and
- 3.6. d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development including housing, to more sustainable locations.
- 3.7. The Planning Practice Guidance (PPG) provides the methodology required to undertake the Sequential and Exception Tests.

Flood and Water Management Act (2010)

- 3.8. The Flood and Water Management Act places a duty on all flood risk management authorities to co-operate with each other. The act also provides lead local flood authorities and the Environment Agency with a power to request information required in connection with their flood risk management functions.

Gravesham Local Plan Core Strategy (2014)

- 3.9. The Gravesham Local Plan Core Strategy sets out the vision, strategic

objectives, and policies for development in Gravesham for the period 2014 to 2028.

- 3.10. The main concern in the Gravesham is the risk of tidal flooding from North Sea storm surges which would affect the River Thames. Most of the areas alongside the river have a high standard of protection by defences. However, a risk of flooding still exists in these areas because of the possibility of defence failure or over-topping during extreme events.
- 3.11. The Local Policy states, that The Thames Estuary 2100 (TE2100) project aims to develop a long term tidal flood risk management plan for London and the Thames Estuary. The TE2100 Flood Risk Management Plan shows that there are unlikely to be major changes to the existing system of defences over the plan period. However, it is likely that there will be changes in the longer term. All the options include a new flood defence to the northeast of Gravesend and some of the options include a new Thames flood barrier, either at Long Reach, Dartford, or between Gravesend and Tilbury. This needs to be taken into account in the Council's approach.
- 3.12. The strategic policy relevant to flooding and drainage is CS18: Climate change.

Flood Risk

- With the exception of the previously developed sites along the Thames Riverside (see Policies CS03, CS04 and CS05) and those other regeneration sites which have already been evaluated in accordance with the sequential and exception tests at the application stage, development will be directed sequentially to those areas at least risk of flooding.
- Proposals in areas at risk of flooding must be accompanied by a Flood Risk Assessment (in accordance with national policy and Environment Agency standing guidance as appropriate) and a Flood Risk Management Plan (if required) to demonstrate that they are adequately defended and safe over their lifetime. Planning permission will be refused for schemes which do not pass the sequential and exception tests.
- The Council will prioritise the maintenance, improvement or replacement of flood defence infrastructure over other land uses where relevant. In addition to meeting their own flood defence and management needs, the Council will expect new development to take advantage of opportunities

to reduce the causes and impacts of flooding from all sources where it is technically and financially feasible.

Sustainable Drainage and Surface Water Run-Off

- The Council will seek to minimise the impact of drainage from new development on waste water systems. In particular, the Council will:
 - Require that surface water run-off from all new development has, as a minimum, no greater adverse impact than the existing use; and
 - Require the use of Sustainable Drainage Systems on all developments where technically and financially feasible.

Flood Risk to Communities Gravesham, Kent County Council (2017)

- 3.13. This document has been prepared for the residents and businesses of the Gravesham Borough Council area. It provides information on the nature and magnitude of the flood risk across the district and outlines the existing and proposed approaches to manage the risk identified.

Strategic Flood Risk Assessment of Kent Thameside (2005)

- 3.14. The Strategic Flood Risk Assessment primary goal is to enable the two participating Borough Councils (Dartford and Gravesham) to undertake the PPG25 sequential test, and thereby directly inform the strategic planning of Kent Thameside through analysing the consequence of existing and proposed development in high flood risk areas.
- 3.15. The SFRA will also allow partners involved in the investment and delivery planning of future developments to gain a better understanding of the cost implications of flood risk management.
- 3.16. The study provides an analysis of the main sources of flood risk in Kent Thameside, together with a means of testing development allocations and existing planning policies for flood risk management. Mitigation options are also proposed.
- 3.17. The SFRA states that:
- The sequential approach to development in flood risk areas set out in PPG25 will be followed;

- Inappropriate development should not be allocated or permitted in zones 2 and 3 of the floodplain or areas with a history of groundwater flooding, or where it would increase flood risk elsewhere, unless there is over-riding need and absence of suitable alternatives;
- Where development is proposed for parts of zones 2 and 3, local authorities (in the case of plan allocations) and developers (in the case of specific proposals) with advice from the Environment Agency should undertake a Strategic Flood Risk Assessment (SFRA) to provide a comprehensive understanding of the flood risk and options for managing that risk in a cost effective manner. This should have regard to climate change and identify appropriate types of development and suitable mitigation and adaptation measures in scheme design and layout;
- Existing flood defences will be protected from development. Where development is permitted in appropriately defended floodplains it must be designed to be resilient to flooding (to minimise potential damage) and to allow for the future maintenance, realignment or management of the defences to be undertaken.

Kent and Medway Structure Plan 2006 mapping out the future (2006)

3.18. Policy NR9 refers to Development and Flood Risk. It states:

- Development will be planned to avoid the risk of flooding and will not be permitted:
 - I. if it would be subject to an unacceptable risk of flooding or where it would increase the risk of flooding elsewhere;
 - II. Where it would prejudice the capacity and integrity of flood plains or planned flood protection or coastal defence measures;
 - III. it will hinder the implementation of future flood protection or coastal defence measures;
 - IV. if it would adversely affect the ability of the land to drain. Where development is necessary in areas at risk of flooding it should be designed and controlled to mitigate the impact of flood risk.

3.19. Local Development Documents will include policies to:

- (a) ensure that a risk based sequential approach, reflecting degrees of flood

risk, is adopted in guiding specified categories of development away from flood risk areas;

(b) secure the provision and maintenance of appropriate drainage systems in new developments to mitigate flood risk;

(c) ensure that proposals for development are accompanied by flood risk assessments appropriate to the scale and nature of the development and the risk.

3.20. Policy NR10 refers to flood protection.

- The development of new or replacement flood protection or coastal defence measures that are in accordance with a Catchment Management Plan, Shoreline Management Plans or Coastal Defence Strategies will be supported. Where these are required to service a development their provision and maintenance should be funded as part of that development.

SFRA Update (2009)

3.21. Kent Thameside Delivery Board have requested update to the SFRA (2005) in the following areas:

- Update the tidal breach modelling for six of the original tidal breaches with the latest sea-level rise data;
- Propose a scope and timeframe for further updating the SFRA.

3.22. The original SFRA analysed twelve defence breach locations, the SFRA Update is reviewing only six of these. The SFRA has assessed the consequence of flood defence failure. The likelihood of the extreme tide events occurring is low (0.1% annual probability of occurrence), but as the original SFRA demonstrates, the consequences are very significant. The likelihood of defence failure is also low and when combined with the probability of the occurrence of the extreme tidal event, the likelihood of flooding is very low. Nonetheless, the consequence of a breach remains very high.

4. Climate Change Allowances

- 4.1. The Planning Practice Guidance states that to allow for the predicted impacts of climate change on sea level rise within the South-East River Basin District (Thames River Basin), the following increases detailed in **Table 4-1** below should be allowed for.

South-East River Basin District	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2124 (mm)	Cumulative rise 2024 to 2125 (metres)
Higher Central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
Upper End	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60

Table 4-1: South-East River Basin District Sea Level Allowances

- 4.2. The Planning Practice Guidance states that to allow for the predicted impacts of climate change on surface water runoff within the Medway Management Catchment, the following increases detailed in **Table 4-2** below to rainfall intensity should be allowed for.

Medway Management Catchment peak rainfall allowance	Higher Central	Upper End
3.3% annual exceedance rainfall event		
2050s	20%	35%
2070s	20%	35%
1% annual exceedance rainfall event		
2050s	20%	45%
2070s	25%	40%

Table 4-2: Medway Management Catchment peak rainfall allowances

- 4.3. For development with a lifetime up to or beyond 2100, the upper end allowances should be used.

5. Sequential and Exception Test

Sequential Test

- 5.1. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available Sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.
- 5.2. The development comprises the installation of various pieces of infrastructure on and within close proximity of Denton Jetty and Mark Lane in Gravesham. In terms of flood risk vulnerability, the proposed development proposals are considered to be water compatible. As a result, the Sequential Test is not required.

Exception Test

- 5.3. In terms of flood risk vulnerability, the proposed development proposals are considered to be water compatible. In line with Table 2 of the Planning Practice Guidance (Replicated below in **Table 5-1**), the Exception Test is not required.

Table 2: Flood risk vulnerability and flood zone 'incompatibility'

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	X	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	X	X	X	✓ *

Key:

✓ Exception test is not required

X Development should not be permitted

Table 5-1: Flood Risk Vulnerability and Flood Zone Incompatibility

6. Sources of Flooding

Flood Zone Designation

6.1. Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. The NPPF Planning Practice Guidance defines Flood Zones as follows:

- **Flood Zone 1: Low Probability.** Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
- **Flood Zone 2: Medium Probability.** Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map).
- **Flood Zone 3a: High Probability.** Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
- **Flood Zone 3b: The functional Floodplain.** This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:
 - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
 - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

6.2. According to the Environment Agency's indicative flood map for planning, as illustrated in **Figure 6-1** below, the entire site is located within Flood Zone 3, defined as having a high risk of flooding associated with the tidally influenced River Thames.

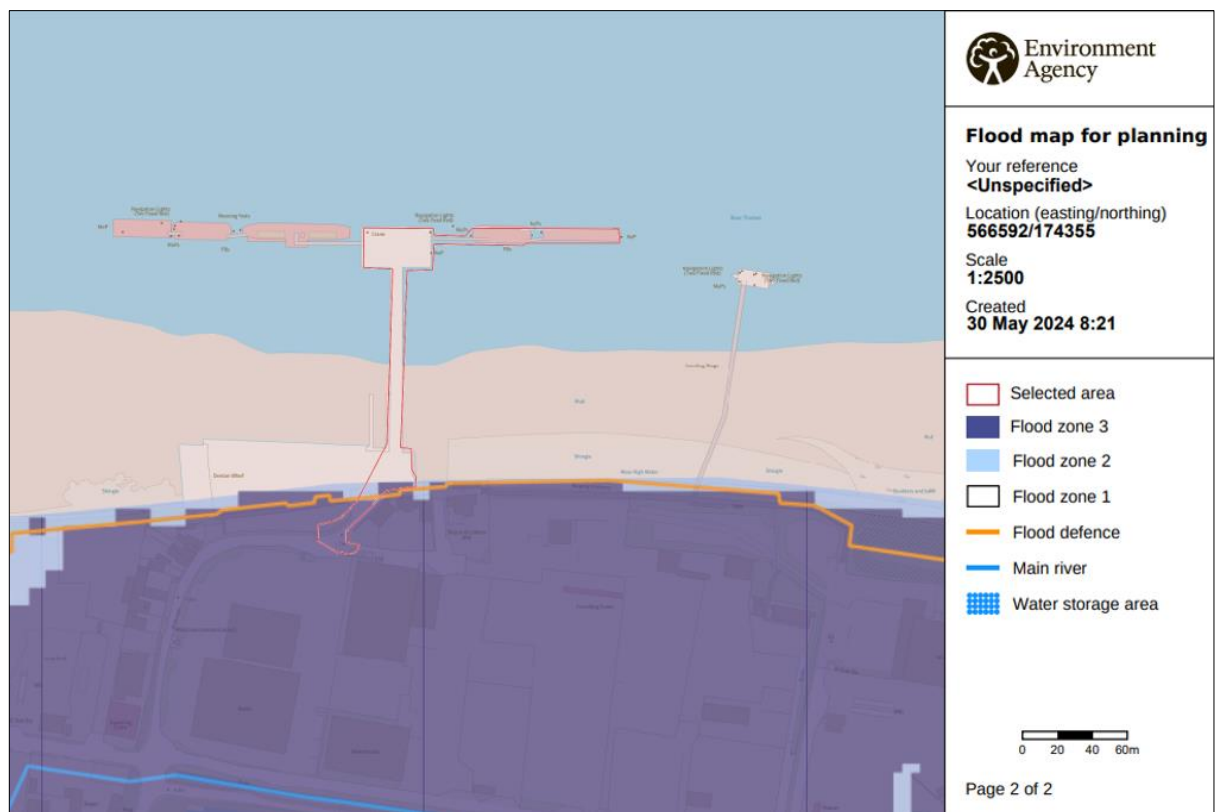


Figure 6-1: EA Flood Map for Planning with Red Line Boundary

Tidal Flood Risk (River Thames)

- 6.3. The TE2100 Extreme Water Level at node 3.27 was taken from Thames Estuary 2100 Phase 3 Set 2 Estuary Wide Options Hydraulic Modelling Study.
- 6.4. The 2100 epoch 0.1% AEP climate change level at node 3.27 is 6.38m AOD which is 0.19m below the River Thames flood defence level of 6.57m AOD.

Residual Flood Risk (Breach Scenario)

- 6.5. The south side of the site is in an area benefitting from flood defences located along the River Thames north of the site. These defences are known as the River Thames Tidal Defences (RTTD).
- 6.6. Therefore, at the south side of the site there (south of the defence wall) is a residual risk of flooding in the event these defences are breached or overtopped. The standard of protection is provided up to the 1 in 1000 year level and the Environment Agency regularly monitors the condition of their flood defences and has a 5 year maintenance programme for them.
- 6.7. According to the Spatial Flood Defences including Standardised Attributes shapefile provided by the EA, the current actual crest level at the lowest spot

north of the site is stated as 6.57m AOD. The EA inspect the defences twice a year to ensure that they remain fit for purpose.

- 6.8. As mentioned above, the south side of the Site is benefiting from the Thames Tidal Defences and as such there is a residual risk in the event of a breach in the defences.
- 6.9. A Breach Analysis was undertaken by Atkins as part of the London Thames Breach Assessment in May 2018 (Thames Estuary Breach Assessment, Thames Barrier to Gravesend and Linford).
- 6.10. The breaches downriver of the Thames Barrier are undertaken for two return period events for two epochs to consider current and future hydrological conditions of the River Thames, namely the 2005 epoch 0.5% AEP and 0.1% AEP events, and the 2115 epoch 0.5% AEP and 0.1% AEP events.
- 6.11. This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites within London. The model simulates 3149 continuous tidal breaches along the entire extent of the Thames from Thames Barrier to Gravesend.
- 6.12. For the 2115 epoch with a 0.5% AEP (1 in 200 year), the highest simulated breach flood level reaches a maximum of 5.09m AOD.

Surface water

- 6.13. The Environment Agency's Risk of Flooding from Surface Water map indicates that most of the site is categorized as having a 'very low' risk of surface water flooding. The south portions of the site associated with Mark Lane is classified as 'low' risk.

Groundwater SFRA

- 6.14. According to Kent Thameside SFRA, the site falls outside of the groundwater risk zone and as such, the ground risk is considered low.

Sewer flooding SFRA

- 6.15. The Kent Thameside SFRA, does not provide any sewer flooding data close to the site and as such, the sewer flooding is considered low.

Reservoir

The site is shown to be outside of the extent of flooding from reservoirs and as such, the risk is considered low.

7. Flood Risk Management

- 7.1. The level of Denton Jetty, located near the Feeder Pillar's B and C and Feeder Pillar D next to the River Thames Flood defence wall, is determined using 1m composite LiDAR data from 2022 obtained from the Environment Agency open data source. Based on the assumption that the jetty is at the same level as the entrance road, it can be estimated the jetty is at a level of 4.50m AOD
- 7.2. The ground level south of the River Thames flood defences in the vicinity of the 2 No. DNO Kiosk/UKPN GRP and Feeder Pillar A (immediately south of Mark Lane) equates to 3.30m AOD.
- 7.3. Based on the Thames Estuary Hydraulic Modelling (2008) modelled extreme water level results, the infrastructure north of the flood defence wall will flood.
- 7.4. The 2 No. DNO Kiosk/UKPN GRP and Feeder Pillar A to the south of the River Thames flood defences will be at a residual risk of flooding for the 200 year climate change tidal event. This is residual flood risk and considered low due to the ongoing flood defence maintenance as part of the TE2100 programme.
- 7.5. Despite the installation of the proposed infrastructure components on Denton Jetty and south of Mark Lane, the nature of the development is de-minis in terms of its footprint and as such the proposal will not contribute to an increased flood risk elsewhere.
- 7.6. To provide a certain degree of protection during low order flood events, all of the proposed Low Voltage Feeder Pillar's/cabinets will be elevated by 400mm above the current ground levels.
- 7.7. At the Feeder Pillar's B and C on Denton Jetty, the 1 No. Feeder Pillar D adjacent the flood defence wall and 2 No. DNO Kiosk/UKPN GRP and Feeder Pillar A south of the flood defences, the system will trip automatically once water is detected above the plinth which sits 400mm above existing ground levels. The system can also be tripped remotely if needed. A similar system exists at the southern feeder/supply point south of the flood defences.
- 7.8. In the event of extreme water levels on the River Thames, the Feeder Pillar's/cabinets/infrastructure installed are classified as water compatible and will flood (rated IP 65).

8. Sustainable Drainage Statement

- 8.1. DEFRA's Non-statutory technical guidance for Sustainable Drainage Systems and CIRIA Guidance C753 "The SuDS Manual" have been used to determine the appropriate SuDS Strategy, which considers the spatial and environmental constraints of the Site.
- 8.2. The development is to install infrastructure components within the site which does not result in an increase in impermeable area as the proposed location of the infrastructure are already impermeable.
- 8.3. The runoff from the areas accommodating the 2 No. Feeder Pillars B and 1 No. Feeder Pillar C on Denton Jetty and the 1 No. Feeder Pillar D immediately north of the flood defence wall (comprising areas of 3.44m² and 0.90m² respectively) will continue to discharge to the tidal River Thames as it currently does.
- 8.4. The runoff from the areas accommodating the 2 No. DNO Kiosk/UKPN GRP and 2 No. Feeder Pillar A immediately south of Mark Lane comprising an area 6.10m² will continue to drain as it currently does.
- 8.5. Based on the information provided and no increase in impermeable area, and it would be disproportionate to implement a sustainable drainage strategy for such a small area.

9. Summary and Conclusions

- 9.1. Ardent Consulting Engineers has been commissioned by Net Zero Marine to support a planning permission to install various pieces of infrastructure on and within the vicinity of Denton Jetty and Mark Lane respectively in Gravesham.
- 9.2. This Flood Risk Assessment considers the current policy relating to flood risk, including the National Planning Policy Framework, and local policy related to the Gravesham Borough Council.
- 9.3. The entire site is located within Flood Zone 3, defined as having a high risk of flooding associated with the tidally influenced River Thames. The predominant risk of flooding at the site is tidal.
- 9.4. Though the site is located within Flood Zone 3, the Sequential and Exception Tests are not required. In terms of flood risk vulnerability, the proposed development proposals are considered to be water compatible and meet the requirements in terms NPPF and its practice guidance.
- 9.5. The south side of the site is located in an area benefitting from flood defences located along the River Thames north of the site. These defences are known as the River Thames Tidal Defences (RTTD). The standard of protection is provided up to the 1 in 1000 year level. Therefore, at the south side of the site there is at residual risk of flooding in the event these defences are breached or overtopped.
- 9.6. Due to the source of flooding (Tidal Flooding), the size of the development infrastructure, which will flood, will not result in an increase in flood risk.
- 9.7. Other sources of flooding for the area south of the River Thames flood defence wall are low.
- 9.8. In conclusion, this Flood Risk Assessment demonstrates that the proposals are consistent with the aims of NPPF, its planning practice guidance and the councils Core Strategy policies. The proposed development will not increase flood risk offsite.

Appendix A

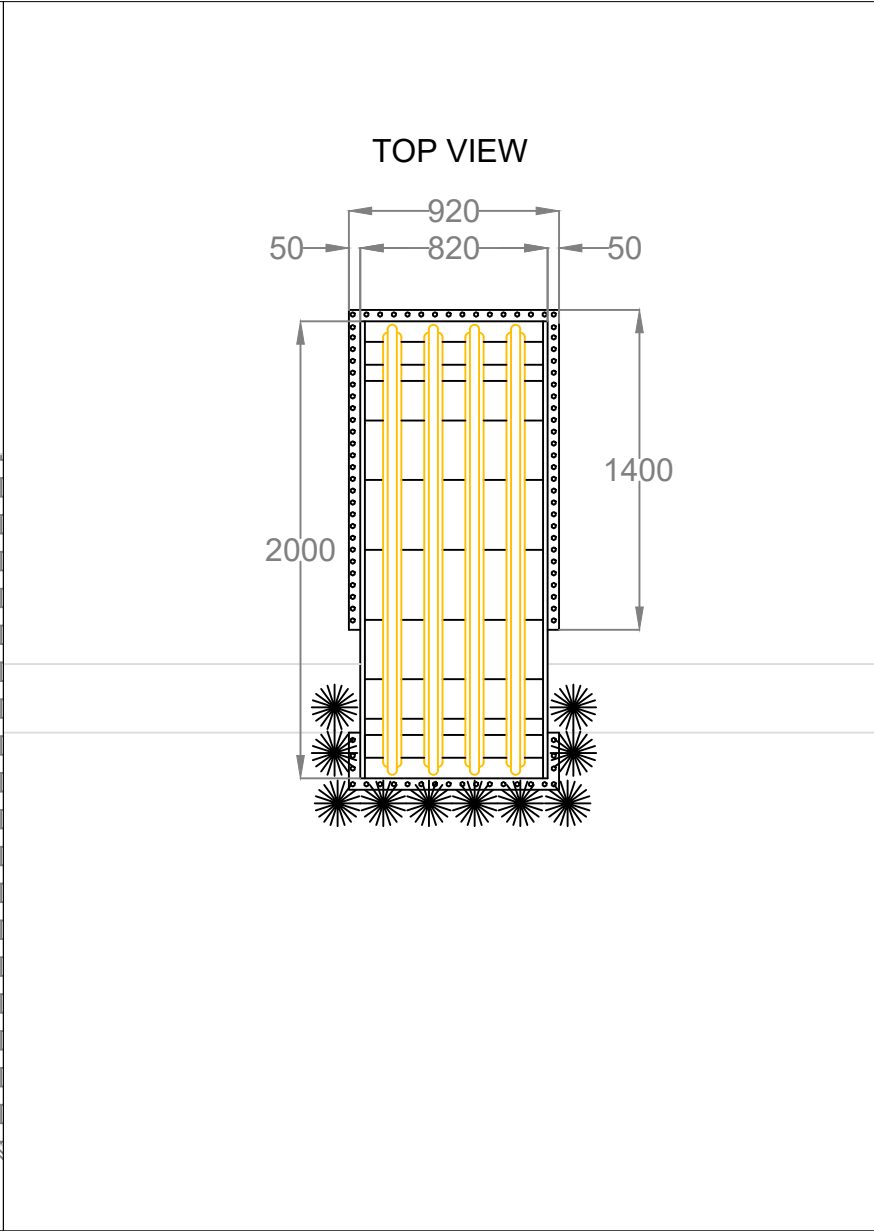
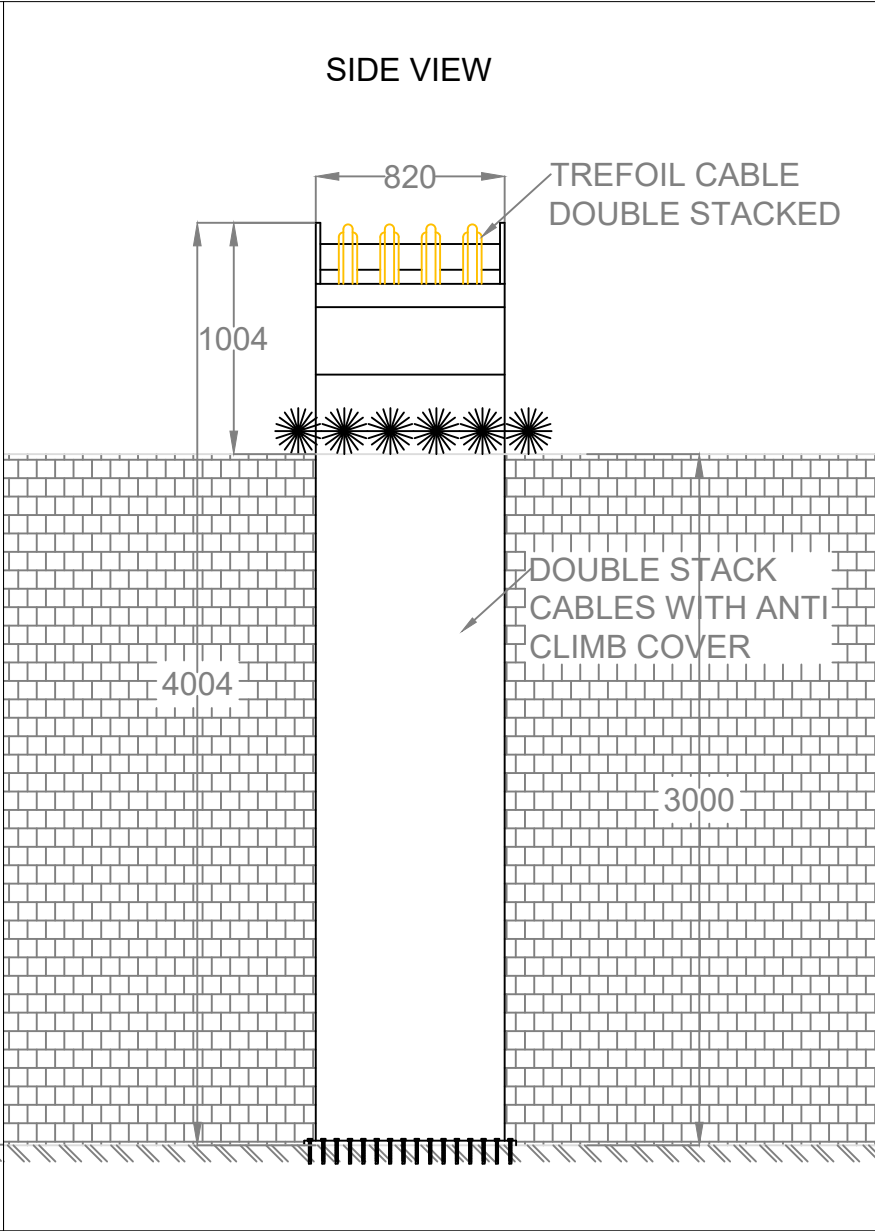
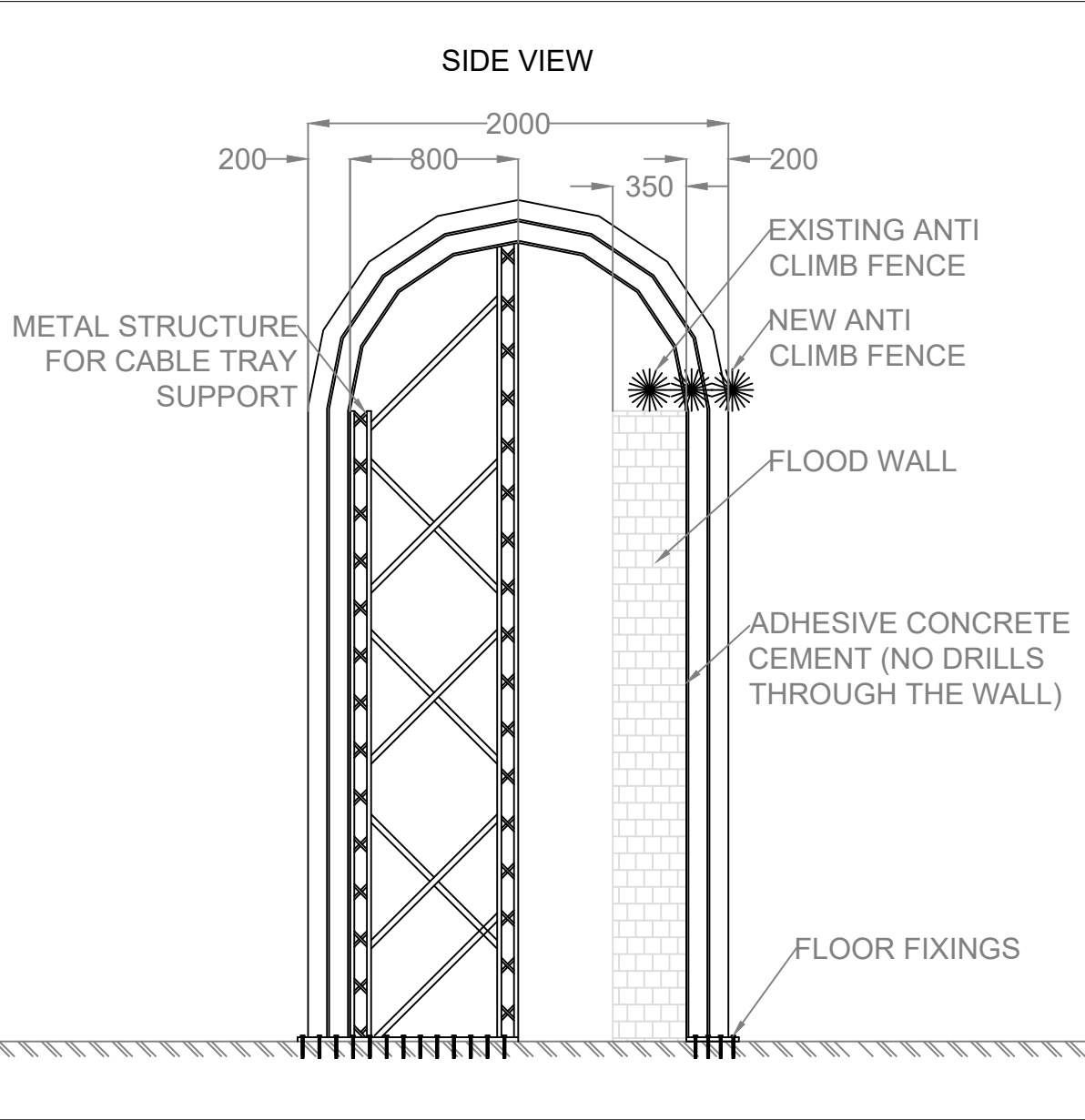
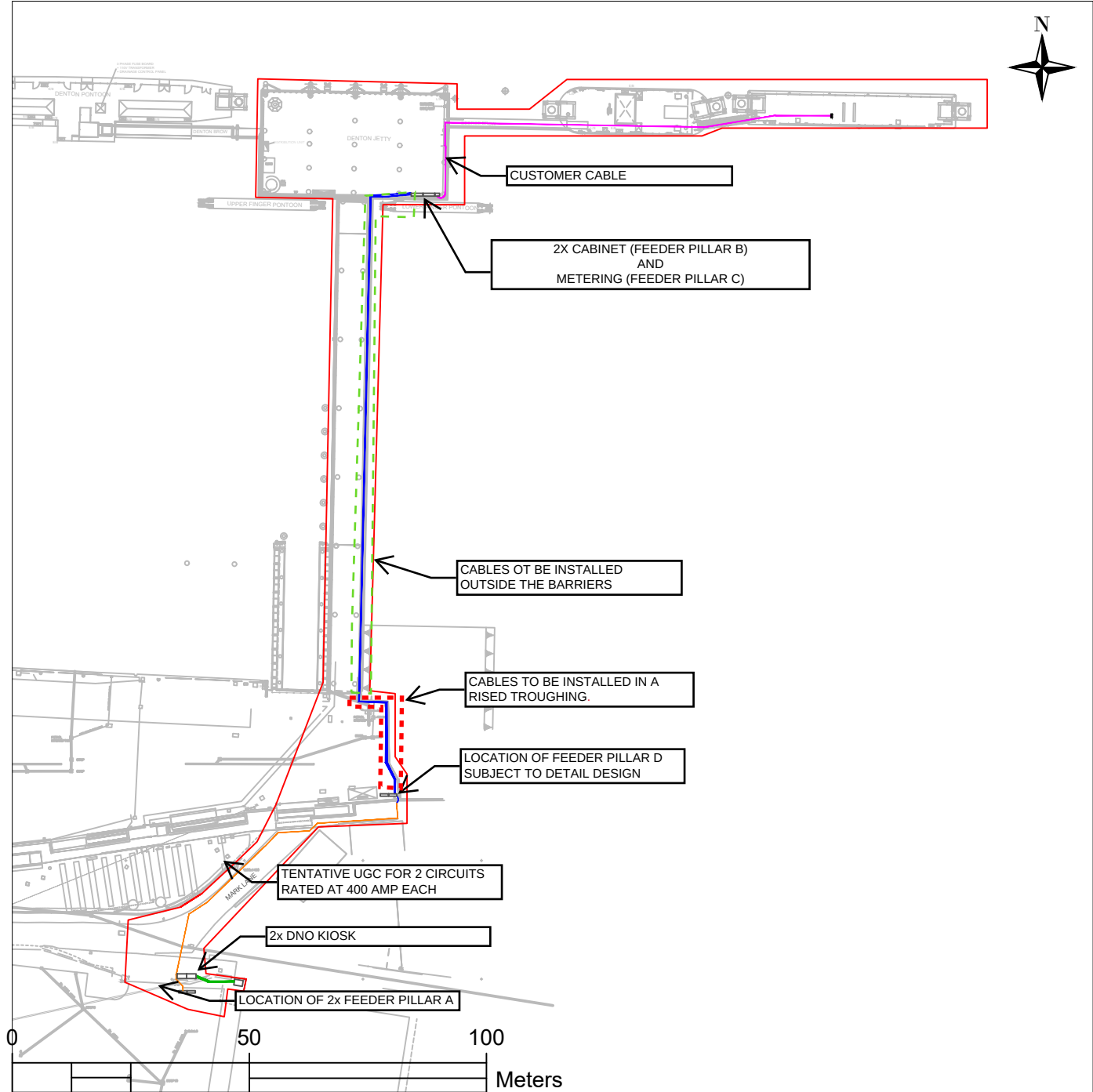


FIGURE 1. PROPOSED SITE PLAN

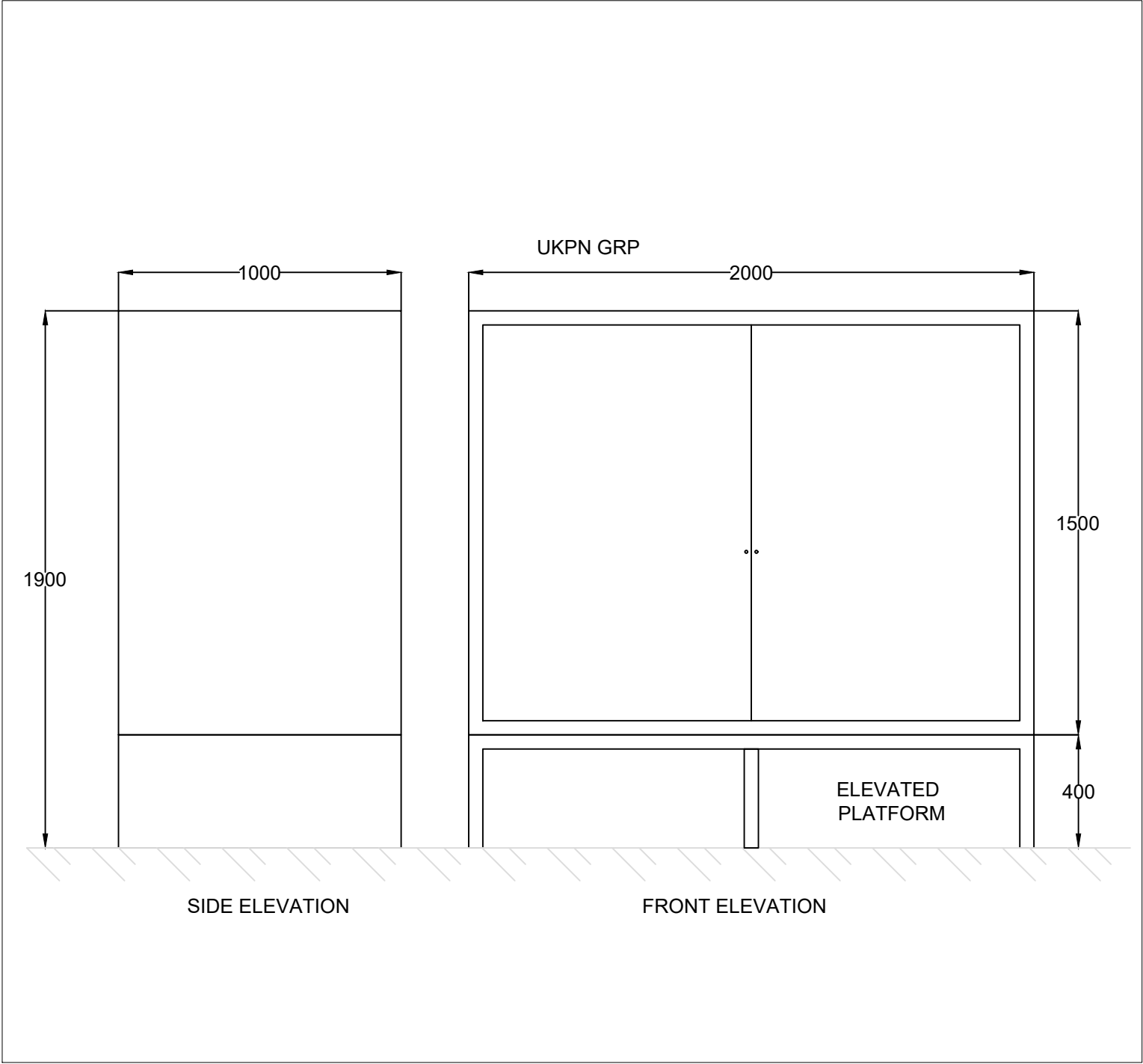


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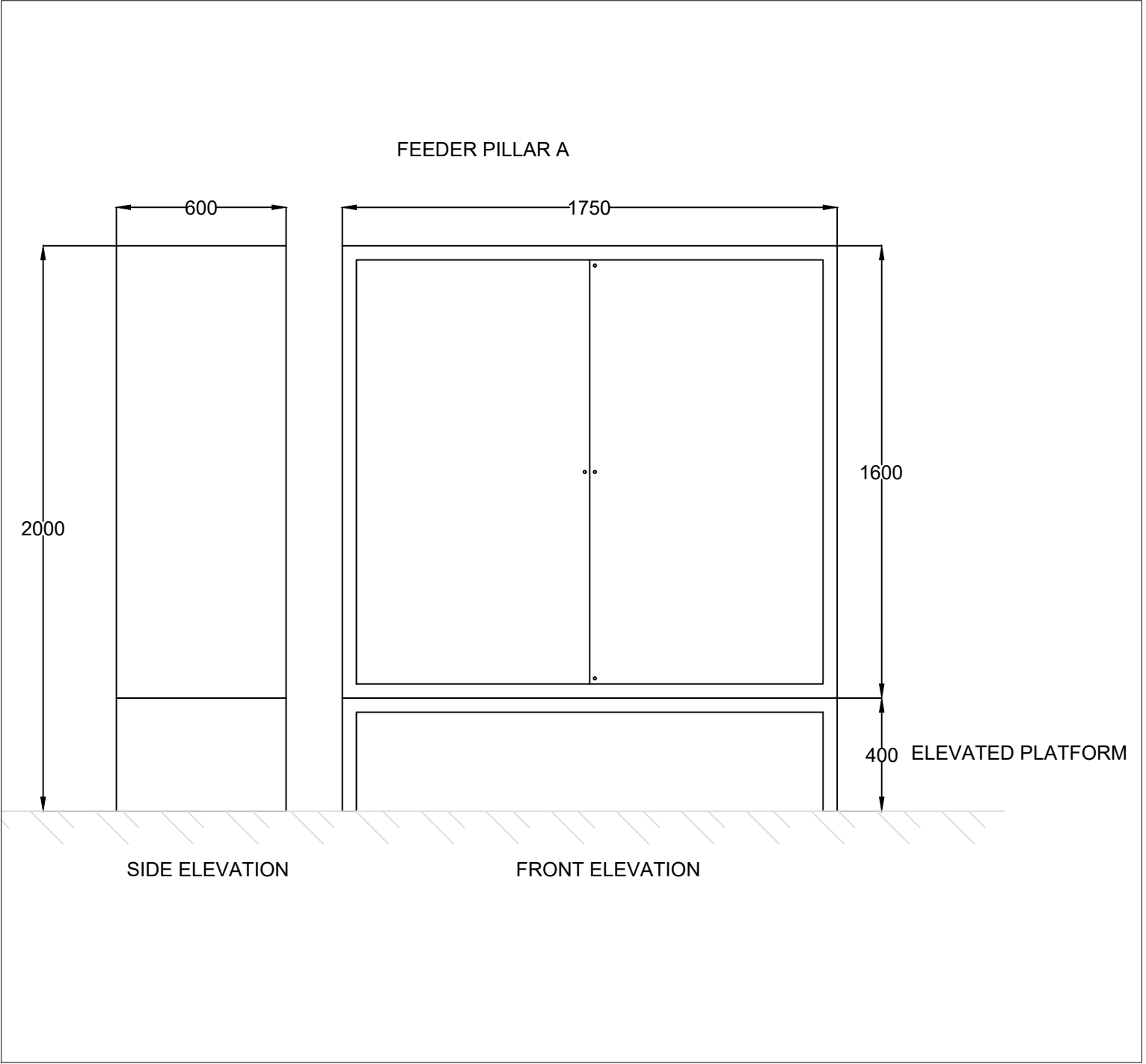
RED LINE: APPLICATION BOUNDARY

FIGURE 1. UKPN GRP



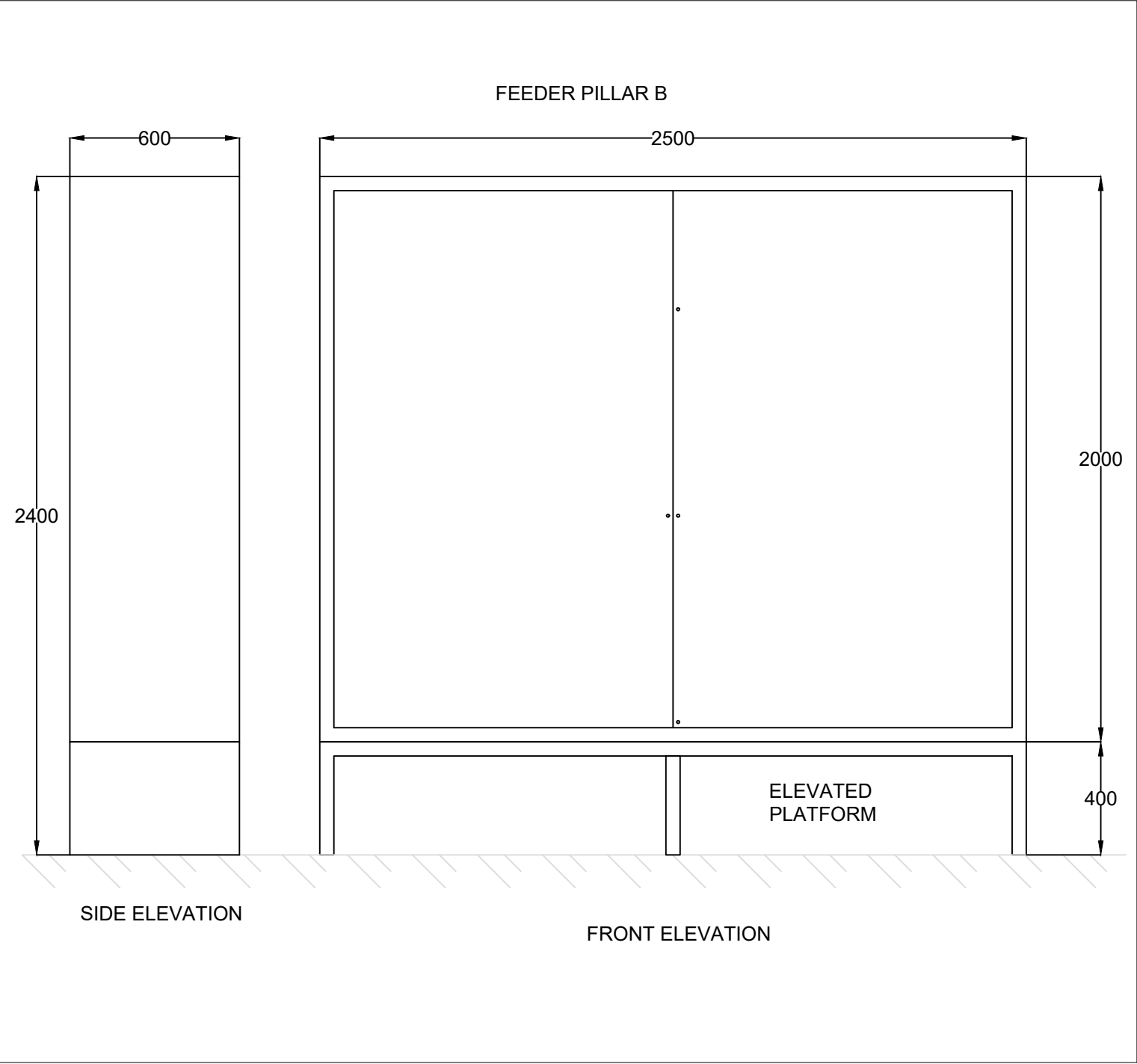
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FIGURE 1. FEEDER PILLAR A



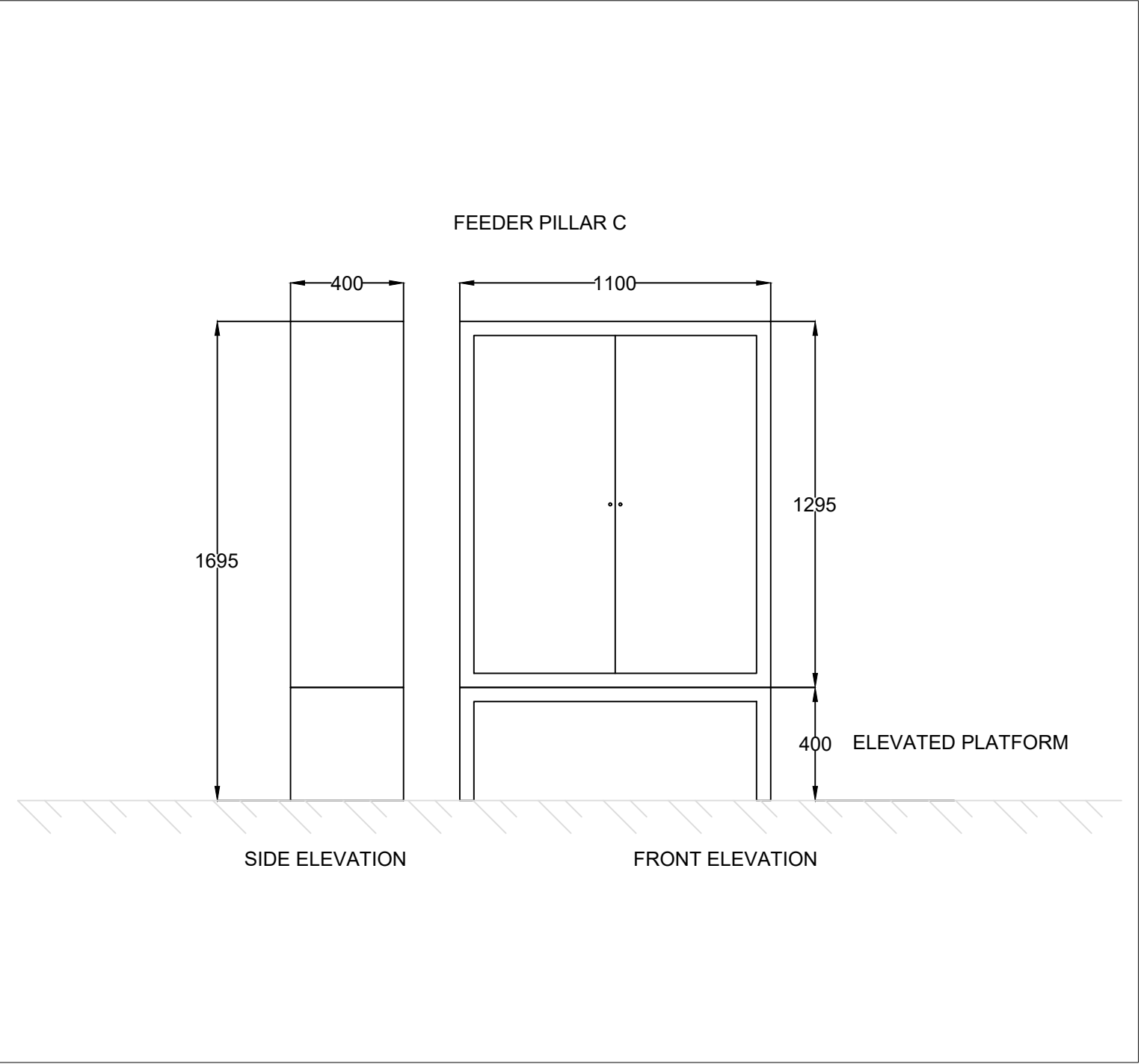
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FIGURE 1. FEEDER PILLAR B



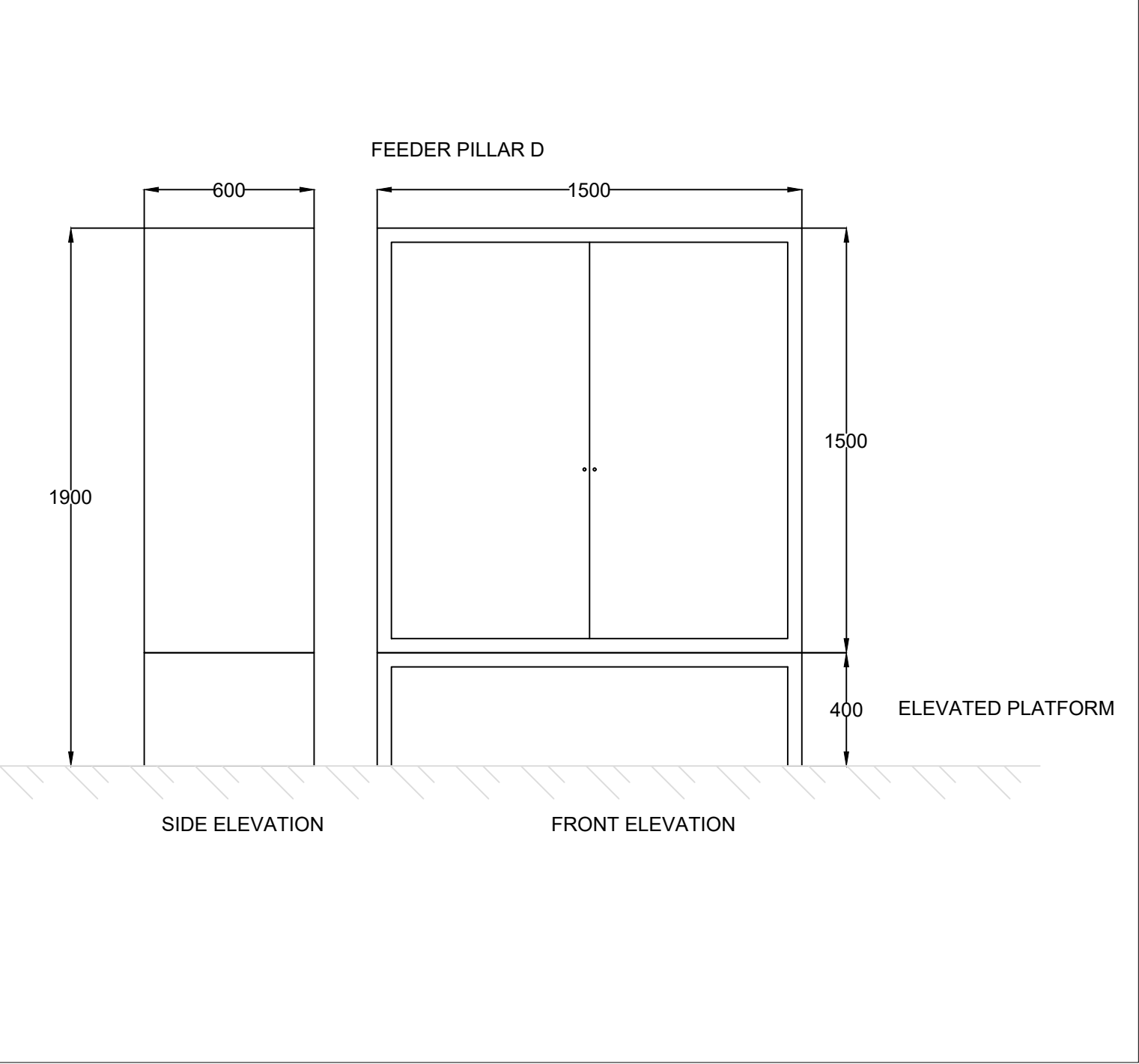
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FIGURE 1. FEEDER PILLAR C



SCALE: 1:20

FIGURE 1. FEEDER PILLAR D



SCALE: 1:20